GREENBOOK
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Fezile Dabi
District Municipality

Fezile Dabi District Municipality

Adaptation Plan

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Title:	Fezile Dabi District Municipality: Adaptation Plan
Authors:	Ilse Kotzee, Amy Pieterse, Lethabo Chilwane & Willemien van Niekerk
Project lead:	Amy Pieterse (CSIR)
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List of Acronyms and Abbreviations

CSIR	**Council for Scientific and Industrial Research**
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFFE	Department of Forestry, Fisheries and the Environment
DM	District Municipality
DRR	Disaster risk reduction
FDDM	Fezile Dabi District Municipality
IPCC	Intergovernmental Panel on Climate Change
LRT	Let's Respond Toolkit
SPLUMA	Spatial Planning and Land Use Management Act, 2013 (Act No.16 of 2013)

Glossary of Terms

Adaptation actions	A range of planning and design actions that can be taken by local government to adapt to the impacts of climate change, reduce exposure to hazards, and exploit opportunities for sustainable development (CSIR, 2023).
Adaptation planning	The process of using the basis of spatial planning to shape built-up and natural areas to be resilient to the impacts of climate change, to realise co-benefits for long-term sustainable development, and to address the root causes of vulnerability and exposure to risk. Adaptation planning assumes climate change as an important factor while addressing developmental concerns, such as the complexity of rapidly growing urban areas, and considers the uncertainty associated with the impacts of climate change in such areas – thereby contributing to the transformational adaptation of urban spaces. Adaptation planning also provides opportunities to climate proof urban infrastructure, reduce vulnerability and exploit opportunities for sustainable development (National Treasury, 2018; Pieterse, 2020).
Adaptive capacity	"The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (IPCC, 2022, p. 2899).
Climate change adaptation	"In human systems, the process of adjustment to **actual** or **expected** climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to **actual** climate and its effects; human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2022, p. 2898).
Climate change mitigation	"A human intervention to reduce emissions, or enhance the sinks, of greenhouse gases (GHGs)" (IPCC, 2022, p. 2915). The goal of climate change mitigation is to achieve a reduction of emissions that will limit global warming to between 1.5°C and 2°C above preindustrial levels (Behsudi, A, 2021).
Climate hazards	Climate hazards are a sub-set of natural hazards and a grouping of hydrological, climatological, and meteorological hazards. This includes the spatial extent and frequency of, among others, floods, fires, and extreme weather events such as extreme rainfall and extreme heat. Sometimes referred to as hydrometeorological hazards. The potential occurrence of a climate hazard may cause loss of life, injury, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (IPCC, 2022). Climate hazards can increase in intensity and frequency with climate change (Pieterse et al., 2023).

Climate risk	Risk implies the potential for adverse consequences resulting from the interaction of vulnerability, exposure, and a hazard. Relevant adverse consequences include those on "lives and livelihoods, health and well-being, economic and sociocultural assets, [as well as] infrastructure and ecosystems" (IPCC, 2022, p. 144). In the IPCC's 6th Assessment Report, it is confirmed that risks may result from "dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system" (IPCC, 2022, p. 132).
Coping capacity	"The ability of people, institutions, organizations and systems, using available skills, values, beliefs, resources and opportunities, to address, manage, and overcome adverse conditions in the short to medium term" (IPCC, 2022, p. 2904).
Disaster risk reduction	"Denotes both a policy goal or objective, as well as the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard or vulnerability; and improving resilience" (IPCC, 2022, p. 2906).
Exposure	Exposure implies the physical exposure of elements to a climate hazard. It is defined as the "presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected [by climate hazards]" (IPCC, 2022, p. 2908).
Mainstreaming	The process of integrating climate change adaptation strategies and measures into existing planning instruments and processes as opposed to developing dedicated adaptation policies and plans (Pieterse et al., 2021).
Resilience	"The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation" (IPCC, 2022, pp. 2920–2921).
Sensitivity	"The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)" (IPCC, 2022, p. 2922).
Vulnerability	Vulnerability is defined as the "propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm, and lack of capacity to cope and adapt" (IPCC, 2022, p. 2927). Vulnerability refers to the characteristics or attributes of exposed elements, i.e., elements that are exposed to potential climate-related hazards. Vulnerability is a function of sensitivity and (coping or adaptive) capacity (Pieterse et al., 2023).

1. Introduction

Climate change impacts vary widely from region to region in South Africa, and are reflected by floods, droughts, heatwaves, and coastal erosion, among others. These impacts directly threaten life, economic well-being, property, infrastructure, and ecosystems, as well as the ability of local government to provide public services. It is local government's responsibility and duty to provide leadership in planning and preparing to manage these risks for the sake of the well-being, safety, and security of individuals within their jurisdiction (SABS, 2023). The purpose of this document is to strengthen the capability of local government to prepare for climate change threats and associated risks.

The Climate Change Adaptation Plan and its accompanying Risk Profile report have been specifically drafted for the Fezile Dabi District Municipality, with the aim of strengthening its strategic response to climate change. These documents derive their insights from the GreenBook (www.greenbook.co.za), a freely accessible online planning support system. The GreenBook is a unique and invaluable resource, providing quantitative scientific evidence to assist local governments in comprehending their climate risks. It plays a pivotal role in guiding the adaptation of settlements to withstand the impacts of both current and future climate challenges.

Designed as an information-rich tool, the GreenBook caters to South African local governments, offering insights into risks and vulnerabilities associated with population growth, climate change, exposure to hazards, and the vulnerability of critical resources. Moreover, the GreenBook not only diagnoses these challenges but also provides practical adaptation measures. These measures are essential for cities, towns, and settlements, empowering local government to mitigate the impacts of climate hazards on communities, the environment, the economy, and municipal assets and infrastructure, while aligning with broader developmental goals (refer to Green Book l Adapting settlements for the future).

The Climate Risk Profile report and the Climate Change Adaptation Plan serve distinct yet interlinked purposes and strategic objectives. They aim to:

1. Drive and advance the local climate change response agenda.
2. Provide a foundational framework for strategy and planning within the District Municipality.
3. Systematically identify and prioritise risks and vulnerabilities.
4. Pinpoint and prioritise targeted interventions and responses.
5. Facilitate the integration of climate change response, particularly adaptation, into mainstream policies and practices.

In essence, these documents are instrumental in equipping the Fezile Dabi District Municipality with a comprehensive strategy to navigate the complexities of climate change, reduce vulnerability and exposure, and champion sustainable development.

The Adaptation Plan briefly outlines the policies constituting the framework for adaptation planning and implementation in South Africa. It then goes on to describe generic adaptation principles, approaches, pathways, and various categories of actions. Subsequently, the plan suggests a specific adaptation strategy for Fezile Dabi District Municipality by aligning it with adaptation goals, programmes, and actions designed to address priority risks, as well as an implementation framework, designed to identify appropriate actors and enable the implementation of the strategy. Finally, the document concludes with recommendations aimed at

facilitating the integration of the proposed actions into broader initiatives, ensuring their effective mainstreaming.

1.1. Policy Framework

South Africa's institutional policy and legislative framework makes provision for climate change adaptation at all levels of government, with local governments increasingly identified as the primary drivers of climate change adaptation. For instance, there exists various national policy and legislative mechanisms that promote, necessitate, guide and/or regulate climate change adaptation at the local level. These include the Disaster Management Amendment Act, i.e. Act 16 of 2015, the Spatial Planning and Land Use Management Act (SPLUMA), i.e., Act No. 16 of 2013, the Climate Change Bill, i.e., B9 of 2022, the 2011 National Climate Change Response White Paper, as well as the 2019 National Climate Change Adaptation Strategy.

While the **Disaster Management Amendment Act** requires each organ of state, as well as provincial and local government to identify measures for, as well as indicate plans to invest in, disaster risk reduction (DRR) and climate change adaptation. **SPLUMA** identifies the principles of (1) spatial resilience – which involves accommodating "flexibility in spatial plans, policies and land use management systems, to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks" (Republic of South Africa., 2013, p. 20) – some of which may be induced by the impacts of climate change, and (2) spatial sustainability, which sets out requirements for municipal planning functions such as spatial planning and land use management to be carried out in ways that consider protecting vital ecosystem features such as agricultural land, i.e., from both anthropogenic and natural threats, including the impacts of climate change, as well as in ways that consider current and future costs of providing infrastructure and social services in certain areas (e.g., uninformed municipal investments may lead to an increase in the exposure of people and valuable assets to extreme climate hazards) – amongst the key principles intended to guide municipal planning and development. The **Climate Change Bill** sets out climate change response requirements for all organs of state across all levels of government, as well as the institutional arrangements necessary to meet those requirements. Amongst them is the requirement for every District Intergovernmental Forum to serve as a Municipal Forum on climate change that coordinates climate response actions and activities in its respective municipality, as well as the requirement for every metropolitan and district municipality to report on their climate change response needs and draft resultant climate risk assessments, as well as climate change response and -implementation plans.

Moreover, the **National Climate Change Response White Paper** identifies local governments as critical role players that can contribute towards effective climate change adaptation through their various functions, including human settlement planning; urban development; municipal infrastructure and services provision; water and energy demand management; and local disaster response, amongst others. The **National Climate Change Adaptation Strategy** outlines several actions that are applicable at local government level, including the development and implementation of adaptation strategies and vulnerability reduction programmes for communities and individuals that are most at risk to the impacts of climate change; the development of municipal early warning systems; as well as the integration of climate change adaptation into municipal development plans and relevant sector plans.

1.2. Outline of the Climate Change Adaptation Plan

Figure 1 below outlines the structure of the report, and includes a description of the development process, and components, of the Climate Change Adaptation Plan for the Fezile Dabi District Municipality. The first chapter introduces the District's Climate Change Adaptation Plan and provides an overview of the national policy context for climate change adaptation planning and implementation, as well as an outline of the structure of the Adaptation Plan. Chapter 2 outlines the adaptation planning framework that forms the basis for the District's Climate Change Adaptation Plan, and consists of adaptation principles, an adaptation approach, as well as adaptation goals, programmes and actions. Chapter 3 provides a summary of the District Municipality's Climate Risk Profile report, which includes an overview of the climate projections, vulnerabilities and impacts identified for the District Municipality, as well as the key climate-related risks that need to be prioritised when undertaking climate change response. Chapter 4 outlines the adaptations goals, programmes and actions identified for the District Municipality, as informed by the key climate-related hazards facing the District. Chapter 5 provides a framework for the implementation of the adaptation programmes and actions identified for the Fezile Dabi District Municipality and considers the local government functions and actors (including nongovernmental actors) responsible for the implementation of the identified actions, as well as the costs and level of priority associated with each adaptation action. Chapter 6 provides recommendations on how the District Municipality can mainstream the identified programmes and actions into existing municipal processes and instruments, with the aim to ensure that climate change considerations are an integral part of all that local government is doing.

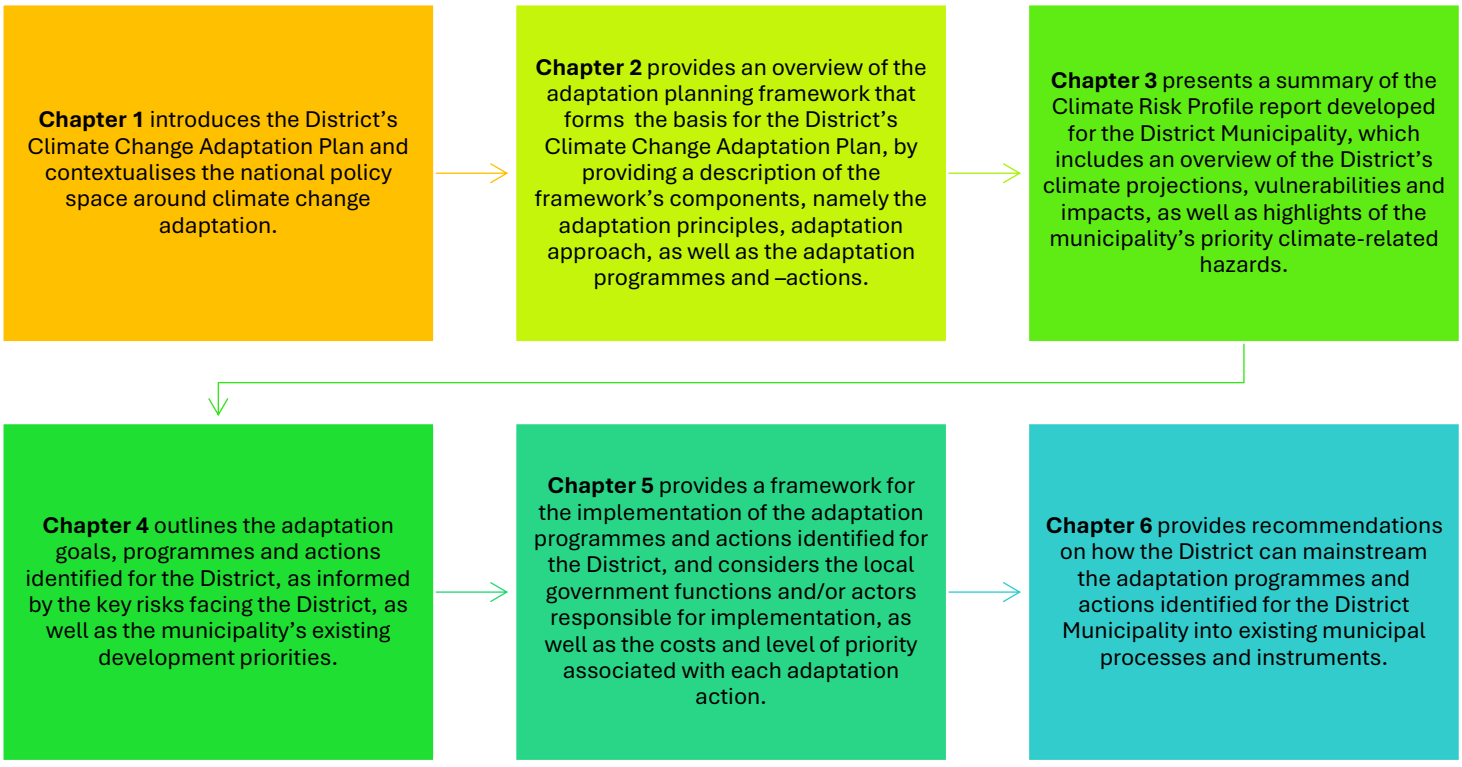

Figure 1: Outline of the Climate Change Adaptation Plan.

2. Adaptation Planning Framework

Climate change mitigation and adaptation refer to the two primary strategies aimed at addressing the adverse effects of climate change, i.e., by either delaying, reducing, redistributing, or avoiding the impacts. Although disaster risk reduction and climate change mitigation form part of the overall climate change response agenda, the focus of this plan is on adaptation.

Climate change adaptation aims to reduce climate-related risks by adjusting a system to the actual or anticipated climate and seeking "to moderate or avoid harm [and] exploit beneficial opportunities" (IPCC, 2022, p. 2898) that may derive from unavoidable impacts of climate change such as extreme hazards. The climate change adaptation agenda is concerned with adapting species, people, places, assets, and systems, to the impacts of actual or anticipated climate-related risks and implements various measures or actions to achieve this (Behsudi, 2021; C40, 2020).

This section of the report outlines adaptation principles, drawing from the recommendations by the South African Bureau of Standards. It also presents a structured approach to selecting adaptation options, categorises adaptation actions, and explains the concept of an adaptation pathway.

2.1. Adaptation principles

The Bureau for Standards recently proposed the following principles that apply to local government when adapting to climate change (SABS, 2023):

i. **Accountability:** Local governments not only acknowledge but also assume responsibility for their climate change adaptation efforts. They willingly subject themselves to appropriate scrutiny and accept the duty to respond to this scrutiny.
ii. **Continual learning and improvement:** Recognising the uncertainties in knowledge and the dynamic nature of drivers of change, available knowledge and evidence, and the contextual factors, continual learning and improvement are essential for effective climate change adaptation.
iii. **Mainstreaming and embedding:** The effectiveness of climate change adaptation is maximised when integrated into local government operations, encompassing policies, plans, procedures, risk management, and implementation strategies.
iv. **Flexibility:** Embrace a flexible approach that considers technical, social, administrative, political, legal, environmental, and economic circumstances. This allows for the accommodation of a diverse range of data availabilities and technical and institutional capacities to meet goals and objectives.
v. **Practicality:** Set practical and achievable goals and objectives. Impractical targets may hinder the successful realisation of climate change adaptation benefits. Focus on easily measurable indicators/metrics with available underlying data and compare them across scales to avoid imposing additional burdens.
vi. **Prioritisation:** During the identification of adaptation plans and measures, prioritise areas based on the relative characteristics of climate change impacts (magnitude, likelihood, and urgency). Consider the capacities of stakeholders and the local government and community's ability to act.
vii. **Proportionality:** Undertake actions that are most effective under the current circumstances, including economic, social, cultural, and political contexts, capabilities, knowledge, and evidence base. Aspire for continual improvement in identifying and assessing adaptation measures.

viii. **Relevance:** Facilitate assessments that provide decision-makers and practitioners with meaningful information for adaptation planning, considering appropriate spatial scales and relevant time durations.

ix. **Transparency:** Ensure that reports and communications on climate change adaptation are openly, comprehensively, and understandably presented, providing accessible information for all interested parties (SABS, 2023).

These principles should be considered when formulating adaptation goals, programmes, and measures (also referred to as 'actions').

2.2. Adaptation approach

The approach that was followed to develop this adaptation plan revolves around comprehending the climate-related risks and implementing adaptive measures in response to these risks. Climate-related risk encompasses the potential for adverse consequences arising from the interplay of vulnerability, exposure, and the occurrence of climate hazards (IPCC, 2022). The components of risk are dynamic, with the occurrence of climate hazards influenced by both natural climate variability and anthropogenic climate change. The exposure of individuals, the built environment, and the natural surroundings to climate hazards is driven by both planned and unplanned development and growth. Vulnerability is the inherent characteristics that make systems sensitive to the effects and impacts of climate hazards.

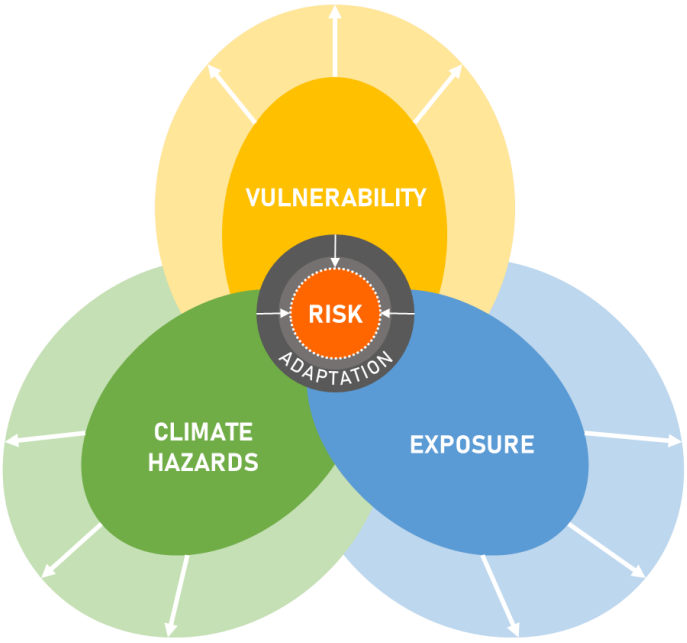

Figure 2: The interplay between hazards, vulnerability and exposure that determines risk (based in IPCC, 2014 and IPCC, 2021)

The inherent uncertainty in future climate trends underscores the necessity for a flexible response and the formulation of adaptable, medium to long-term adaptation strategies.

The approach followed in this plan involves the following steps:

i. Gain an understanding of climate risk in a specific geographic area.
ii. Identify priority climate hazards/zones based on the risk profile.
iii. Establish adaptation goals to mitigate the risk associated with priority hazards/zones.
iv. Develop adaptation programmes with measures/actions to achieve these goals.
v. Integrate climate considerations into other sector plans/instruments/strategies.

Refer to Table 1 for a more detailed description of this approach.

Table 1: The adaptation approach

Understand climate risk for a specific geographic area	A climate risk profile assesses risk by determining – in a specific geographic area and at a specific scale – the likelihood of a hazard to occur, the inherent vulnerability of various systems, and exposure of these systems to specific climate hazards. To be able to develop an appropriate adaptation plan, it is important to understand what contributes to risk and vulnerability.
Identify priority climate-related risks/zones	Identify the climate hazards and impacts that pose the greatest risk at present and in the future within a geographic area. If possible, also identify climate risk zones that need to be prioritised for intervention.
Establish adaptation goals	Identify adaptation goals to address priority risks/zones that speak to policy goals.
Develop adaptation programmes and actions	Develop adaptation programmes that speak to the identified adaptation goals and identify appropriate adaptation actions under each of the programmes that are mutually supportive. Adaptation actions should: • Be specific to a climate hazard/vulnerability/exposure. • Suggest a target or an indicator to measure progress. • Be assignable to a primary implementer. • Consider co-benefits and other possible implications. • Include mitigation as far as it builds resilience or reduces exposure and vulnerability.
Mainstream climate considerations into planning	Integrate evidence of climate risk, adaptation goals, programmes, and actions into existing instruments and processes. The aim is to ensure that climate change considerations are an integral part of all that local government is doing.

The primary aim of an adaptation plan is to address both current and anticipated future risks and vulnerabilities while also leveraging opportunities for long-term transformation and sustainable development.

2.3. Adaptation programmes and actions

An adaptation programme is a structured and systematic set of actions, initiatives, and interventions aimed at local governments to adapt their localities to the impacts of climate change. It involves the practical implementation of specific goals identified in the plan.

Broadly, adaptation actions include anticipatory and reactive measures. Anticipatory adaptation involves proactive measures taken in preparation for anticipated climate change impacts, while reactive adaptation entails responding to climate change effects as they are experienced. Furthermore, it facilitates the integration and prioritisation of climate change adaptation and resilience measures into various planning mechanisms and processes (CSIR, 2023).

A spectrum of adaptation actions is at the disposal of municipalities to enhance resilience and mitigate risks posed by changing climatic patterns and extreme weather events. Some of the categories of actions include:

- Infrastructure development, encompassing the construction of, for example, seawalls, levees, and storm surge barriers to protect against rising sea levels and extreme weather events. These engineered solutions provide immediate protection and buy time for longer-term adaptation efforts but are mostly very expensive to build.
- Green infrastructure initiatives offer sustainable and nature-based solutions. Municipalities can implement urban green spaces, green roofs, and permeable pavements to absorb excess water, reduce flooding, and mitigate the urban heat island effect. Such approaches not only enhance climate resilience but also contribute to improved air quality and overall urban liveability.
- Environmental protection such as restoring ecosystems like mangroves, dunes, and wetlands, not only provides natural buffers but also supports biodiversity.
- Integrated urban planning is essential to create climate-resilient municipalities. Land-use regulations should be adapted to consider climate risks, prioritising construction practices that enhance resilience. Elevating structures above projected flood- and sea levels and using climate-resilient materials in building design can minimise the impacts of flooding and storm damage.
- Early warning systems and emergency preparedness plans are critical tools to ensure swift responses to extreme weather events, minimising the impact on vulnerable communities.
- Innovative water management strategies are essential for municipalities facing changing precipitation patterns and increasing water scarcity. Diversifying water sources, implementing water efficiency measures, and investing in advanced stormwater management systems contribute to water security and sustainable resource use.
- Engagement and education are pivotal components of successful adaptation strategies. Empowering officials, and residents, to understand and respond to climate risks through awareness campaigns, education programmes, and participatory planning initiatives can enhance local adaptive capacity (CSIR, 2023).

Local governments must embrace a combination of structural, natural, and community-based approaches to build resilience and adaptive capacity, protect vulnerable communities, while ensuring long-term sustainability in the face of evolving climate challenges.

2.4. Stakeholder engagement process

To construct a Climate Change Adaptation Plan resonating with the specific requirements of the Fezile Dabi District Municipality, while appropriately addressing its significant risks – a stakeholder engagement component was factored into the adaptation planning process, which gave district municipal officials and practitioners a platform to provide meaningful input on both the Risk Profile Report and Adaptation Plan. The first stakeholder engagement focused on the Climate Risk Profile report of the District Municipality, with the aim of validating the climate-related risks identified for the District (as flagged in the Risk Profile report), while securing the District's confirmation of the adaptation goals proposed in response to the identified risks. The second engagement took place after a draft Climate Change Adaptation Plan was developed. As part of this engagement, each climate change adaptation programme identified under each goal, as well as each of the actions associated with the adaptation programmes, were intensely workshopped with the District and relevant local municipal officials/stakeholders, in an effort to gather comprehensive input that would help the project team finalise the document. Municipal officials and practitioners from various sectors – particularly those sectors that are either most vulnerable to climate change impacts, or those that are well-positioned to respond to climate change, particularly through adaptation were present during these engagements. This was done in an effort to fulfil section 7.1 (a) of the Climate Change Bill, and to achieve a holistic response to climate change. All engagements took place virtually.

The engagement on the development of Fezile Dabi District Municipality's Climate Change Adaptation Plan took place on Wednesday 6 June 2024. The meeting was attended by representatives from various departments in the district including disaster management services as well as the disaster management department of Moqhaka Local Municipality. Stakeholders from the Free State Umbrella Fire protection association were also in attendance

The stakeholder engagement process offered a platform to interact with District stakeholders, thus, promoting a more profound comprehension of the District Municipality's context. Feedback gleaned from these engagement procedures has been deliberated upon and woven into the final draft Climate Change Adaptation Plan.

3. Summary of Climate Risk Profile

A Climate Risk Profile Report was prepared by the team, designed to complement this Plan. The Climate Risk Profile report serves as an essential resource for understanding the risks associated with climate change in Fezile Dabi District Municipality.

This section of the Plan summarises the climate risk profile for Fezile Dabi District Municipality, drawing from the GreenBook Risk Profile Tool (available at: https://riskprofiles.greenbook.co.za/). Please consult the accompanying Climate Risk Profile Report for more detailed information.

3.1. Climate projections, vulnerabilities and impacts

The main climate projection for the Fezile Dabi District Municipality show a generally hotter and wetter climate, with more extreme rainfall events. Future projections show increases in temperature up to 3.36°C. Rainfall predictions show future average annual rainfall expected to range between 32.34 mm to 227.32 mm across the district. The number of very hot days is expected to increase up to 34 very hot days for some parts of the district. The likelihood of settlements in Fezile Dabi being exposed to wildfires is projected to be high. High

flood likelihood is also projected for some of the settlements in the district. The projected change in number of extreme rainfall days ranges between 0 to 5 days across the district. This indicates a potential shift towards more intense precipitation events in comparison to the current conditions. Water supply vulnerability is expected to increase significantly in the future across the district, this is due to an increase in mean annual evaporation and increased population growth. Increase in heat stress can have a negative impact on maize production towards 2050. Yield and crop suitability of wheat will also decline over time as temperatures start to exceed critical crop thresholds. Hot and moist conditions can cause increased spread of disease and parasites.

3.2. Priority climate-related hazards

The greatest climate risks faced across the Fezile Dabi District are increased temperatures, a considerable degree of uncertainty and variability regarding future precipitation patterns as well as significant increases in extreme rainfall. Changes in annual rainfall could have significant consequences for water availability, agriculture, ecosystems, and various socio-economic activities. Whereas an increase in extreme rainfall events can have significant implications for water management, infrastructure resilience, and disaster preparedness. Extreme rainfall may also lead to additional challenges such as increased flooding erosion, and strain on drainage systems. The projected wildfire risk for 2050 is high for certain settlements in the district. This underscores the importance of adaptive planning and resilience-building measures to mitigate potential risks and capitalise on opportunities associated with changing precipitation patterns. Fezile Dabi District Municipality is currently experiencing issues of water scarcity and quality which will be futher exacerbated with future climate change impacts.

4. Adaptation Goals, Programmes and Actions

The section outlines the adaptation plan using goals and measures designed to help Fezile Dabi DM to adapt to the impacts of climate change. Based on the assessment of the potential risks and vulnerabilities posed by climate change, this plan was developed as a proactive strategy to mitigate these risks and enhance resilience.

4.1. Adaptation goals

Drawing upon the assessment of the current and projected climate-related risks and vulnerabilities outlined in the preceding section, the following adaptation goals for Fezile Dabi DM were identified, prioritising those risks with the highest potential impact. These goals were validated by stakeholders during the nationwide engagements:

- Goal 1: To ensure water security for human consumption and irrigation under a changing climate.
- Goal 2: To reduce the quantity, improve the quality, and slow the flow of stormwater runoff from developed areas, and to identify suitable areas for managing water runoff.
- Goal 3: To ensure that space is set aside for recreation, ecological support and stormwater management.
- Goal 4: To increase the adaptive capacity of human settlements to climate change and extreme events.
- Goal 5: To increase resilience of the agricultural sector to more extreme events such as heatwaves and storms as well as indirect risks such as pests and diseases.

The adaptation programmes below identify the overarching programmes and their actions, necessary to achieve each one of the goals. Specific timeframes and responsibilities are allocated in the subsequent implementation framework.

4.2. Adaptation programme: Goal 1

To ensure water security for human consumption and irrigation under a changing climate.

Programme 1.1: Enhancing Water Resource Management and Infrastructure

This programme focuses on improving water resource management strategies and enhancing infrastructure resilience to ensure sustainable water supply for human consumption and irrigation amidst climate change impacts. It addresses climate risks such as increased temperatures, variability in precipitation patterns, and extreme rainfall events. The adaptation actions under this programme include:

- **Conducting comprehensive water resource assessments:** This involves conducting detailed hydrological studies and modelling to understand current and future water availability, taking into account projected climate changes such as increased temperatures, and altered precipitation patterns. Vulnerable areas and water sources at risk should be identified to prioritise intervention measures. A co-benefit is that the enhanced understanding of water resource dynamics will lead to improved planning for water allocation.
- **Retrofitting existing water storage facilities:** This involves upgrading existing reservoirs and dams to increase storage capacity and improve their resilience to extreme weather events, such as heavy rainfall and drought. It would be important to ensure that these structures can handle variability in water inflow and prolonged dry periods.
- **Upgrading pipelines and distribution systems:** This entails repairing and modernising water distribution networks to minimise leaks and inefficiencies. Smart water management technologies should be implemented to optimise water use and reduce losses.
- **Promoting water-saving practices and technologies:** This involves launching public awareness campaigns to educate residents and businesses about water conservation. Incentives should be provided for the adoption of water-saving devices such as low-flow faucets and efficient irrigation systems. A co-benefit of this is reduced water bills for consumers.

Programme 1.2 Strengthening Climate Resilience of Water Supply Systems

This programme aims to enhance the resilience of water supply systems against climate-induced risks, including increased temperatures, extreme rainfall events, and wildfire impacts. It focuses on updating infrastructure standards, managing wildfire risks to protect watersheds, and diversifying water sources to ensure a steady supply even under adverse climate conditions. The adaptation actions under this programme include:

- **Developing climate-resilient infrastructure standards:** This involves updating infrastructure design standards to incorporate climate resilience measures, ensuring that new and retrofitted water supply systems can withstand extreme weather events such as heavy rainfall and drought.
- **Implementing wildfire risk management in catchments:** This involves conducting prescribed burns, vegetation management, and erosion control measures in critical catchments to reduce wildfire risks and protect water quality. Early warning systems should be established for wildfires to ensure timely response.

- **Investigating and developing alternative water sources:** This includes exploring options for groundwater recharge, and water reuse to diversify water supply sources. Pilot projects should be developed and implemented to test the feasibility of these alternatives in the local context.

Programme 1.3: Building Institutional Capacity and Stakeholder Engagement
This programme focuses on strengthening institutional capacity and fostering stakeholder collaboration to support effective water management under climate change. It includes improving coordination among agencies, providing training for water professionals, and promoting public participation and awareness in water management and climate adaptation efforts. The adaptation actions under this programme include:

- **Enhancing coordination among government agencies:** This involves establishing multi-stakeholder committees to improve coordination and communication among government agencies, NGOs, and community groups involved in water management. Protocols should be developed for data sharing and joint decision-making.
- **Providing training on climate resilience for water professionals:** This involves developing and delivering training programs on climate resilience, water management, and disaster preparedness for local water professionals, planners, and decision-makers. The district and its municipalities can partner with educational institutions to integrate climate resilience into their curricula.
- **Conducting public awareness campaigns on water management:** This entails organising public forums, workshops, and media campaigns to educate residents about the importance of water conservation, climate risks, and adaptation strategies. Community involvement should be encouraged in water management initiatives.

4.3. Adaptation programme: Goal 2

To reduce the quantity, improve the quality, and slow the flow of stormwater runoff from developed areas, and to identify suitable areas for managing water runoff.

Programme 2.1: Enhancing Green Infrastructure and Natural Water Management
This programme focuses on integrating green infrastructure solutions to manage stormwater runoff, reduce its volume, and slow its flow. The aim is to enhance the natural absorption and filtration of water, thereby improving water quality and supporting the health of downstream water sources. The programme also addresses climate risks such as increased temperatures, extreme rainfall, and wildfires. The adaptation actions under this programme include:

- **Implementing permeable pavements:** This includes replacing traditional impermeable surfaces (e.g., asphalt, concrete) with permeable materials in public spaces, parking lots, and walkways to allow water infiltration and reduce runoff. Pilot projects should be conducted in key areas to demonstrate effectiveness. A co-benefit is enhanced groundwater recharge.
- **Establishing rain gardens and bioswales:** This involves creating rain gardens and bioswales in parks, along streets, and in residential areas to capture and filter stormwater. These features use indigenous plants and engineered soil to enhance water infiltration and pollutant removal. A co-benefit is enhanced biodiversity and improved urban aesthetics.
- **Expanding urban tree canopy:** This involves increasing tree planting initiatives in the urban areas of the district to provide shade, reduce runoff, and improve air quality. Indigenous and drought-resistant species that can withstand climate variability and high temperatures should be used.

- **Developing green roofs and walls:** This includes promoting the installation of green roofs and walls on public and private buildings to capture rainwater, reduce runoff, and provide insulation. Incentives and technical support should be offered for property owners.

Programme 2.2: Improving Stormwater Management Infrastructure

This programme focuses on upgrading and maintaining stormwater management infrastructure to handle increased rainfall variability and intensity. It includes measures to enhance the capacity and resilience of drainage systems, reduce runoff, and protect water quality. The adaptation actions under this programme include:

- **Upgrading drainage systems:** This includes assessing and upgrading existing drainage systems to increase their capacity and resilience to extreme rainfall events. Sustainable drainage systems (SuDS) should be implemented to enhance water infiltration and reduce flood risks.
- **Constructing retention and detention basins:** This entails building retention and detention basins in strategic locations to temporarily store stormwater during heavy rainfall events. These basins help to control the flow of water, reduce peak discharge, and improve water quality through sedimentation. A co-benefit is enhanced groundwater recharge and improved water quality.
- **Implementing check dams and terracing:** This entails constructing check dams and terracing in hilly and sloped areas to slow down waterflow, reduce erosion, and increase water infiltration. These structures help to manage stormwater runoff and protect downstream water sources. A co-benefit is improved soil health and enhanced water retention in the landscape.
- **Promoting rainwater harvesting systems:** This involves encouraging the installation of rainwater harvesting systems in homes, schools, and public buildings to capture and store rainwater for non-potable uses such as irrigation and flushing toilets. Incentives and technical support should be provided for implementation. A co-benefit is reduced water bills.

Programme 2.3: Community Engagement and Capacity Building

This programme focuses on engaging the community and building capacity to manage stormwater and adapt to climate impacts. It includes public awareness campaigns, education initiatives, and stakeholder collaboration to foster a culture of water conservation and resilience. The adaptation actions under this programme include:

- **Conducting public awareness campaigns:** This includes launching campaigns to educate residents about the importance of stormwater management, water conservation, and climate adaptation. Various media channels and community events should be used to disseminate information and promote best practices.
- **Providing training for local authorities and stakeholders:** This involves offering training programmes for local authorities, planners, and community leaders on stormwater management, green infrastructure, and climate resilience. The district and its municipalities can partner with educational institutions and NGOs for capacity-building initiatives.
- **Establish Community-Based Monitoring Programs:** This includes involving local communities in monitoring stormwater runoff, water quality, and the effectiveness of green infrastructure projects. Training and resources should be provided for citizen science initiatives to gather data and inform adaptive management.

- **Developing and implementing water conservation education programmes:** This involves integrating water conservation and climate resilience topics into school curricula and community education programmes. Workshops, fieldtrips, and hands-on activities should be organised to engage students and residents.

4.4. Adaptation programme: Goal 3

To ensure that space is set aside for recreation, ecological support and stormwater management, and to guide decision making across all sectors.

Programme 3.1 Integrated Urban Green Spaces

This programme focuses on the development and maintenance of green spaces within urban areas to provide recreation, ecological support, and effective stormwater management. The aim is to enhance the urban environment's resilience to increased temperatures, extreme rainfall, and wildfire risks while supporting biodiversity and improving the quality of life for residents. The adaptation actions under this programme include:

- **Developing green infrastructure plans:** This involves identifying and designating areas for parks, community gardens, and natural reserves within urban settings. These green spaces should be incorporated into the Spatial Development Framework to ensure balanced growth and ecological support. A co-benefit is improved air quality, enhanced biodiversity and increased recreational opportunities.
- **Implementing urban greening initiatives:** This includes planting indigenous trees and vegetation in public spaces, streets, and residential areas to provide shade, reduce urban heat island effects, and manage stormwater. Green roofs and walls should be created on public and private buildings.
- **Enhancing recreational facilities:** This involves developing and upgrading parks, playgrounds, and sports facilities to provide recreational opportunities for all age groups. It should be ensured that these spaces are accessible and promote physical activity and well-being.
- **Supporting biodiversity:** This entails creating habitats for local wildlife within urban green spaces to promote biodiversity. Conservation projects should be implemented to protect indigenous species and restore natural ecosystems. It is important to identify these sites and to include them in Integrated Development Plans and Spatial Development Frameworks to ensure that they are considered in development decisions and sufficiently protected from the impacts of climate change. A co-benefit is enhanced ecosystem services and improved environmental health.

Programme 3.2: Climate-Resilient Urban Planning

This programme aims to incorporate climate resilience into urban planning processes to ensure sustainable development that can withstand climate risks such as increased temperatures, variable precipitation patterns, and extreme rainfall. The goal is to create urban environments that support ecological functions and provide recreational spaces. The adaptation actions under this programme include:

- **Updating zoning regulations and building codes:** This entails incorporating climate resilience measures into zoning regulations and building codes to guide sustainable development. Provisions for green spaces, stormwater management, and energy efficiency should be included.

- **Conducting climate risk assessments:** This entails assessing the vulnerability of urban areas to climate risks such as heat extremes and water supply issues. The results can be used to inform urban planning and development decisions.
- **Promoting mixed-use development:** This involves encouraging the development of mixed-use areas that combine residential, commercial, and recreational spaces to reduce urban sprawl and enhance community resilience. It should be ensured these areas include sufficient green spaces and infrastructure for stormwater management.
- **Enhancing public transportation and non-motorised mobility**: This involves developing and improving public transportation systems to reduce reliance on private vehicles and lower urban heat. Pedestrian and cycling infrastructure should be promoted. A co-benefit is reduced greenhouse gas emissions and improved air quality.

Programme 3.3 Community Engagement and Capacity Building

This programme aims to engage communities and build their capacity to contribute to climate resilience efforts. It includes public awareness campaigns, education initiatives, and fostering partnerships to ensure inclusive and effective implementation of adaptation measures. The adaptation actions under this programme include:

- **Conducting public awareness campaigns:** This entails educating residents about the importance of green spaces, stormwater management, and climate adaptation. Various media channels and community events can be used to disseminate information and promote best practices.
- **Providing training for local authorities and stakeholders:** This includes offering training programmes for local authorities, planners, and community leaders on climate-resilient urban planning, green infrastructure, and stormwater management. The district and local municipalities can partner with educational institutions and NGOs for capacity-building initiatives.
- **Establishing community-based monitoring programmes:** This entails involving local communities in monitoring green spaces, stormwater management, and the effectiveness of climate adaptation projects. Training and resources should be provided for citizen science initiatives to gather data and inform adaptive management.
- **Developing and implementing climate education programmes:** This includes integrating climate change education and sustainability topics into school curricula and community education programmes. Workshops, fieldtrips, and hands-on activities should be organised to engage students and residents.

Programme 3.4 Ecosystem-Based Adaptation

This programme focuses on using natural systems and processes to enhance the resilience of human settlements to climate change and extreme events. It includes actions to protect, restore, and sustainably manage ecosystems to provide critical services such as stormwater management, temperature regulation, and biodiversity support. The adaptation actions under this programme include:

- **Implementing green infrastructure projects:** This includes developing and maintaining green infrastructure such as parks, wetlands, and green roofs to manage stormwater, reduce flooding, and provide recreational spaces. A co-benefit of this is enhanced biodiversity, improved air quality, and recreational opportunities.

- **Restoring degraded ecosystems:** This entails engaging in reforestation, wetland restoration, and other ecosystem restoration projects to enhance natural resilience to climate impacts.
- **Promoting sustainable land use practices:** This includes encouraging sustainable agriculture, forestry, and land management practices that enhance soil health, reduce erosion, and support water retention.
- **Establishing buffer zones and corridors:** This entails creating buffer zones around critical natural areas and establishing ecological corridors to facilitate wildlife movement and reduce habitat fragmentation. These areas should be included in Spatial Development Framework.

4.5. Adaptation programme: Goal 4

To increase the adaptive capacity of human settlements to climate change and extreme events.

Programme 4.1 Heatwave Preparedness and Response

This programme aims to reduce the vulnerability of human settlements to increasing temperatures and frequent heatwaves. It focuses on improving community resilience through education, infrastructure, and health services to mitigate the impacts of extreme heat. The adaptation actions under this programme include:

- **Conducting heat vulnerability assessments:** This entails identifying high-risk areas in the district and vulnerable populations such as the elderly, children, and outdoor workers. Areas with high heat exposure should be mapped to prioritise interventions.
- **Developing heatwave early warning systems:** This includes implementing systems to provide timely alerts about impending heatwaves. Multiple communication channels (SMS, radio, community announcements) should be used to reach all residents.
- **Establishing cooling centres:** This includes utilising community facilities such as libraries, schools, and recreation centres as cooling centres during heatwaves. These centres should be equipped with sufficient cooling mechanisms and drinking water.
- **Training healthcare workers and emergency responders:** This entails providing training on heat illness prevention, recognition, and treatment. Emergency services should be equipped with necessary supplies to handle heat-related emergencies.
- **Implementing urban greening initiatives:** This includes increasing tree planting and the creation of green spaces to reduce the urban heat island effect. The use of green roofs and walls in buildings to provide natural cooling should be encouraged.

Programme 4.2 Climate-Resilient Infrastructure and Urban Planning

This programme focuses on enhancing the resilience of urban infrastructure and incorporating climate adaptation into urban planning processes. It aims to ensure that human settlements can withstand increased temperatures, variable precipitation patterns, extreme rainfall, and wildfires. The goal is to reduce vulnerabilities and improve the overall sustainability of urban environments. The adaptation actions under this programme include:

- **Conducting vulnerability assessments of critical infrastructure:** This entails assessing the resilience of healthcare facilities, schools, housing, and other critical infrastructure to climate impacts. Areas should be identified and prioritised for retrofitting and upgrades.

- **Implementing low-cost retrofitting measures:** This entails retrofitting existing buildings with improved insulation, reflective roofing materials, and enhanced drainage systems to handle increased rainfall and reduce flooding risks.
- **Updating zoning regulations and building codes:** This entails incorporating climate resilience measures into zoning regulations and building codes to guide sustainable development. Provisions for green spaces, stormwater management, and fire-resistant materials should be included.
- **Promotion of mixed-use development:** This involves encouraging the development of mixed-use areas that combine residential, commercial, and recreational spaces to reduce urban sprawl and enhance community resilience. These areas should include green spaces and infrastructure for stormwater management.

Programme 4.3 Water Security and Management

This programme aims to ensure a reliable and sustainable water supply for human consumption and irrigation under changing climate conditions. It addresses vulnerabilities related to water supply, including increased temperatures, variability in precipitation, and extreme rainfall, by implementing water conservation, management, and infrastructure improvements. The adaptation actions under this programme include:

- **Enhancing water conservation and efficiency:** This involves promoting the use of water-saving devices and appliances in households and businesses. Public education campaigns should be conducted on the importance of water conservation. A co-benefit of this is reduced water consumption and lower utility bills.
- **Developing and maintaining rainwater harvesting systems**: This involves implementing community-based rainwater harvesting projects and encouraging the installation of rainwater tanks in homes and public buildings. A co-benefit is enhanced water availability and reduced pressure on municipal water supplies.
- **Protecting and restoring water sources:** This entails establishing protection zones around critical water sources to prevent pollution and engage in watershed management practices to maintain healthy water ecosystems.
- **Improving infrastructure for water storage and distribution:** This includes upgrading existing water storage facilities to increase capacity and repair water distribution networks to reduce leaks and inefficiencies.

Programme 4.4 Community Engagement and Capacity Building

This programme focuses on engaging communities and building their capacity to contribute to climate resilience efforts. It includes public awareness campaigns, education initiatives, and fostering partnerships to ensure inclusive and effective implementation of adaptation measures. The adaptation actions under this programme include:

- **Facilitating participatory climate risk assessments:** This entails engaging community members in identifying local climate risks and vulnerabilities through participatory mapping and other tools.
- **Developing community resilience plans:** This involves collaborating with local stakeholders to create tailored resilience plans addressing specific climate risks. Clear roles and responsibilities should be included for implementation.

- **Providing capacity-building workshops and training:** This entails offering training sessions on climate adaptation, disaster preparedness, and emergency response to empower community leaders and local organisations.
- **Strengthening social networks and support systems:** This includes promoting the formation of neighbourhood associations, peer support groups, and other community networks to improve collective resilience to climate impacts.

4.6. Adaptation programme: Goal 5

To increase resilience of the agricultural sector to more extreme events such as heatwaves and storms as well as indirect risks such as pests and diseases.

Programme 5.1 Climate-Resilient Agricultural Practices

This programme aims to promote agricultural practices that enhance the resilience of crops and livestock to climate extremes. It includes implementing techniques that improve soil health, water efficiency, and pest management, ensuring that agriculture can thrive despite adverse climate conditions. The adaptation actions under this programme include:

- **Implementing conservation agriculture techniques:** This includes promoting practices such as minimal soil disturbance, permanent soil cover, and crop rotation to improve soil health and water retention.
- **Adopting drought-resistant crop varieties:** This entails introducing and supporting the use of drought-resistant and heat-tolerant crop varieties to ensure productivity during periods of water scarcity and high temperatures. The co-benefits of this are sustained agricultural yields and reduced irrigation needs.
- **Implementing Integrated Pest Management (IPM):** This involves developing and promoting IPM strategies that combine biological, cultural, physical, and chemical tools to manage pests and diseases sustainably.
- **Utilising shade structures and windbreaks:** This involves establishing shade structures and windbreaks to protect crops from heatwaves and storms, and to reduce soil moisture loss.

Programme 5.2 Water Management and Conservation

This programme focuses on efficient water use and conservation strategies to address the vulnerability of water supply in agriculture. It includes actions to optimise irrigation, harvest rainwater, and manage water resources sustainably. The adaptation actions under this programme include:

- **Installing efficient irrigation systems:** This includes promoting the use of drip irrigation and other water-efficient systems to minimise water use and maximise crop yields.
- **Developing rainwater harvesting systems:** This entails implementing rainwater harvesting infrastructure on farms to collect and store rainwater for irrigation and other agricultural uses.
- **Promoting water-saving practices:** This includes educating farmers on practices such as mulching, contour farming, and the use of cover crops to conserve soil moisture. Co-benefit are improved soil health and reduced water needs.
- **Constructing farm ponds and reservoirs:** This entails supporting the construction of small-scale ponds and reservoirs on farms to store runoff water for irrigation and livestock use.

Programme 5.3 Livestock and Pasture Management

This programme aims to improve the resilience of livestock and pasture systems to climate extremes. It includes actions to enhance feed availability, protect animals from heat stress, and manage pastureland sustainably. The adaptation actions under this programme include:

- **Improving pasture management practices:** This involves implementing rotational grazing and other sustainable pasture management techniques to maintain pasture health and productivity. Co-benefits are improved soil health and pasture resilience.
- **Enhancing livestock housing and shelter:** This involves constructing or retrofitting livestock housing to provide adequate ventilation, shade, and protection from extreme weather.
- **Developing feed and fodder banks:** this entails establishing feed and fodder banks to ensure a stable supply of animal feed during periods of drought or extreme weather.
- **Implementing heat stress management practices:** This entails introducing practices such as providing cool drinking water, shade structures, and cooling systems for livestock during heatwaves. Co-benefits are enhanced animal productivity and health.

Programme 5.4 Capacity building and Knowledge Sharing

This programme focuses on enhancing the knowledge and skills of farmers and agricultural stakeholders to adapt to climate change. It includes training, education, and the dissemination of best practices and innovations. The adaptation actions under this programme include:

- **Conducting climate resilience training for farmers:** This entails organising workshops and training sessions to educate farmers on climate-resilient practices, technologies, and strategies.
- **Developing and disseminating climate information services:** This includes establishing systems to provide timely and accurate climate forecasts and advisories to farmers to inform decision-making. Co-benefits are enhanced preparedness and risk management.
- **Promoting farmer-to-farmer knowledge exchange:** This involves facilitating networks and platforms for farmers to share experiences and best practices in climate-resilient agriculture.
- **Establishing agricultural extension services:** This includes strengthening agricultural extension services to provide ongoing support and advice to farmers on adapting to climate change.

5. Implementation Framework

The implementation framework summarises the adaptation plan and indicate responsibilities, timeframes, and priorities.

5.1. Implementation framework: Goal 1

Goal 1: To ensure water security for human consumption and irrigation under a changing climate.

Adaptation programme 1.1: Enhancing Water Resource Management and Infrastructure				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct comprehensive water resource assessments. In this action hydrological studies and modelling are conducted to understand water availability under changing climate conditions.	Future water supply vulnerability Increase in extreme heat days Increased variability in annual rainfall	Project Management and Public Works: water directorate in collaboration with environmental agencies	Short term	High
i. Retrofit existing reservoirs and dams. In this action existing reservoirs and dams are retrofitted to increase storage capacity.	Future water supply vulnerability Increase in extreme heat days	Project Management and Public Works in collaboration with water utility company Bloem Water	Medium term	High
iii. Upgrade pipelines and distribution systems. In this action water distribution networks should be repaired and modernised to minimise leaks and inefficiencies. Smart water management technologies should be implemented to optimise water use and reduce losses.	Future water supply vulnerability Increase in extreme heat days Increase in extreme rainfall	Project Management and Public Works Department: water directorate	Medium term	Medium
iv. Promote water-saving practices and technologies. In this action public awareness campaigns are launched to educate residents and businesses about water conservation.	Future water supply vulnerability Increase in extreme heat days Increase in extreme rainfall	Environmental Health and Emergency Services Local Water Authority: Technical Services	Short term	High

Adaptation programme 1.2: Strengthening Climate Resilience of Water Supply Systems				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Develop climate-resilient infrastructure standards. In this action infrastructure design standards are updated to incorporate climate resilience measures, ensuring that new and retrofitted water supply systems can withstand extreme weather events such as heavy rainfall and drought.	Increase in extreme heat days Increase in rainfall extremes Increased flood risk	Project Management and Public Works Department: Water Directorate Technical Services	Short term	High
ii. Implement wildfire risk management in catchments. In this action prescribed burns, vegetation management and erosion control measures are conducted in critical catchments to reduce wildfire risk and protect water quality. Early warning systems for wildfires should be established to ensure timely response.	Increase in wildfire risk Increase in temperature	Environmental Health and Emergency Services: Fire unit in collaboration with Fire Protection Association (FPA)	Medium term	High
iii. Investigate and develop alternative water sources. In this action options for groundwater recharge and water reuse are explored to diversify water supply sources for the district. Pilot projects should be developed and implemented to test the feasibility of these alternatives in the local context.	Increased variability in annual rainfall Future water supply vulnerability	Project Management and Public Works Department: Water Directorate, Local Municipality: Technical Services, Department of Water and Sanitation, Free State	Long term	Medium

Adaptation programme 1.3: Building Institutional Capacity and Stakeholder Engagement				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Build institutional capacity and stakeholder engagement In this action multi-stakeholder committees are established to improve coordination and communication among government agencies, NGOs, and community groups involved in water management. Protocols for data sharing and joint decision-making should be developed.	Increased variability in annual rainfall Future water supply vulnerability	Department of Water Affairs (DWA) NGOs Local Municipalities	Short term	High
ii. Provide training on climate resilience for water professionals In this action training programs on climate resilience, water management, and disaster preparedness are developed and delivered for local water professionals, planners, and decision-makers. Partner with educational institutions to integrate climate resilience into curricula.	Increased variability in annual rainfall Future water supply vulnerability Increase in extreme rainfall	Corporate Services Department: Training and Skills unit in collaboration with educational institutions Environmental Health and Emergency Services	Medium term	High
iii. Conduct public awareness campaigns on water management In this action public forums, workshops, and media campaigns are organised to educate residents about the importance of water conservation, climate risks, and adaptation strategies. Community involvement in water management initiatives should be encouraged.	Increased variability in annual rainfall Future water supply vulnerability Increase in extreme rainfall	Environmental Health and Emergency Services Local Municipalities Communities NGOs	Short term	Medium

5.2. Implementation framework: Goal 2

Goal 2: To reduce the quantity of stormwater runoff from developed areas and to slow its flow, thereby improving the quality of water and the health of downstream water sources by identifying suitable areas for managing water runoff.

Adaptation programme 2.1: Enhancing Green Infrastructure and Natural Water Management				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Implement permeable pavements. In this action traditional impermeable surfaces (e.g., asphalt, concrete) are replaced with permeable materials in public spaces, parking lots, and walkways to allow water infiltration and reduce runoff.	Increase in extreme rainfall events. Increased flood risk	Project Management and Public Works	Short term	High
ii. Establish rain gardens and bioswales. In this action rain gardens and bioswales are created in parks, along streets, and in residential areas to capture and filter stormwater. Indigenous plants and engineered soil should be used to enhance water infiltration and pollutant removal.	Increase in extreme rainfall events. Increased flood risk	Project Management and Public, Parks and Recreation Department Local Municipalities: Urban Development and Planning Department	Short term	High
iii. Expand the urban tree canopy. In this action tree planting initiatives are increased in urban areas to provide shade, reduce runoff, and improve air quality. Indigenous and drought-resistant species that can withstand climate variability and high temperatures should be used	Increase in extreme heat days. Increase in extreme rainfall events. Increased flood risk	Environmental Health and Emergency Services	Medium term	Medium
iv. Develop green roofs and walls. In this action the installation of green roofs and walls are promoted on public and private buildings to capture rainwater, reduce runoff, and provide insulation. Incentives and technical support should be offered for property owners.	Increase in extreme heat days. Increase in extreme rainfall events. Increased flood risk	Urban Development and Planning Department Parks and Recreation Department Department of Agriculture	Medium term	Medium

Adaptation programme 2.2: Improving Stormwater Management Infrastructure				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Upgrade drainage systems. In this action existing drainage systems are assessed and upgraded to increase their capacity and resilience to extreme rainfall events. Sustainable drainage systems (SuDS) should be implemented to enhance water infiltration and reduce flood risks.	Increase in extreme rainfall events. Increased flood risk	Project Management and Public Works Department: Water and Sewer directorate Local Municipality: Technical Services Public Works and Infrastructure Department	Medium term	High
ii. Construct retention and detention basins. In this action retention and detention basins are built in strategic locations to temporarily store stormwater during heavy rainfall events. These basins help to control water flow, reduce peak discharge, and improve water quality through sedimentation.	Increase in extreme rainfall events. Increased flood risk	Project Management and Public Works Department: Water and Sewer directorate Local Municipality: Technical Services Public Works and Infrastructure Department	Medium term	High
iii. Implementing Check Dams and Terracing In this action check dams and terracing are constructed in hilly and sloped areas to slow down water flow, reduce erosion, and increase water infiltration. These structures help to manage stormwater runoff and protect downstream water sources.	Increase in extreme rainfall events. Increased flood risk	Agricultural and rural development department Project Management and Public Works Department: Water and Sewer directorate Local Municipality: Technical Services	Long term	Medium
iv. Promote rainwater harvesting systems. In this action the installation of rainwater harvesting systems is encouraged in homes, schools, and public buildings to capture and store rainwater for non-potable uses such as irrigation and flushing toilets. Provide incentives and technical support for implementation.	Increased variability in annual rainfall. Future water supply vulnerability.	Project Management and Public Works Department: Water directorate Local Municipality: Technical Services Disaster Management Parks and Recreation	Short term	High

Adaptation programme 2.3: Community Engagement and Capacity Building				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct public awareness campaigns. In this action campaigns to educate residents are launched about the importance of stormwater management, water conservation, and climate adaptation. Various media channels and community events can be used to disseminate information and promote best practices.	Increased variability in annual rainfall. Increase in extreme rainfall events. Increased flood risk	Environmental Health and Emergency Services Disaster Management Unit Community Services and Development Department	Short term	High
ii. Provide training for local authorities and stakeholders. In this action training programmes are offered for local authorities, planners, and community leaders on stormwater management, green infrastructure, and climate resilience. Municipalities can partner with educational institutions and NGOs for capacity-building initiatives.	Increase in extreme hot days. Increased variability in annual rainfall. Increase in extreme rainfall events. Increased flood risk Increased fire risk	Environmental Health and Emergency Services Disaster Management Unit Community Services and Development Department NGOs Local community	Medium term	High
iii. Establish community-based monitoring programmes. In this action local communities are involved in monitoring stormwater runoff, water quality, and the effectiveness of green infrastructure projects. Training and resources should be provided for citizen science initiatives to gather data and inform adaptive management.	Increased variability in annual rainfall. Increase in extreme rainfall events. Increased flood risk	Environmental Health and Emergency Services Disaster Management Unit Community Services and Development Department NGOs Local community	Medium term	Medium
iv. Develop and implement water conservation education programmes. In this action water conservation and climate resilience topics are integrated into school	Increased variability in annual rainfall. Future water supply vulnerability	Corporate Services Department Community Outreach Schools and higher education	Short term	High

curricula and community education programs. Workshops, field trips, and hands-on activities should be organised to engage students and residents.				

5.3. Implementation framework: Goal 3

Goal 3: To ensure that space is set aside for recreation, ecological support and stormwater management.

Adaptation programme 3.1: Integrated Urban Green Spaces				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Develop green infrastructure plans. In this action areas for parks, community gardens, and natural reserves are identified and designated within urban settings of the district. These green spaces should be incorporated into urban development plans to ensure balanced growth and ecological support.	Increase in extreme rainfall events. Increased flood risk	Project Management and Public Works Department Parks and Recreation Urban Planning and Development	Short term	High
ii. Implement urban greening initiatives. In this action indigenous trees and vegetation are planted in public spaces, streets, and residential areas to provide shade, reduce urban heat island effects, and manage stormwater. Green roofs and walls should be created on public and private buildings.	Increase in extreme rainfall events. Increased flood risk Increase in temperature	Project Management and Public Works Department: Building Directorate Parks and Recreation Urban Planning and Development Environmental Management	Medium term	High
iii. Enhance recreation facilities. In this action parks, playgrounds, and sports facilities are developed and upgraded to provide recreational opportunities for all age groups. These spaces should be accessible and promote physical activity and well-being.	Increased temperature Increase in extreme hot days. Human wellbeing	Parks and Recreation Department	Short term	Medium

iv. Support biodiversity. In this action habitats for local wildlife are created within urban green spaces to promote biodiversity. Conservation projects should be implemented to protect indigenous species and restore natural ecosystems.	Loss of biodiversity Habitat degradation Increase in extreme weather events	Environmental Health and Emergency Services Parks and Recreation Department	Medium term	Medium

Adaptation programme 3.2: Climate-Resilient Urban Planning				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Update zoning regulations and building codes. In this action climate resilience measures are incorporated into zoning regulations and building codes to guide sustainable development. Provisions for green spaces, stormwater management, and energy efficiency should be included.	Increased temperature Increased variability in annual rainfall Increase in extreme rainfall events. Increase in extreme hot days	Project Management and Public Works Urban Development and Planning Department	Short term	High
ii. Conduct climate risk assessments. In this action the vulnerability of urban areas to climate risks such as heat extremes and water supply issues are assessed. The results will be used to inform urban planning and development decisions.	Increase in water supply vulnerability. Increase in extreme hot days. Increase in extreme rainfall events	Environmental Health and Emergency Services Project Management and Public Works Urban Development and Planning Department	Medium term	High
iii. Promote mixed-use development. In this action development of mixed-use areas that combine residential, commercial, and recreational spaces to reduce urban sprawl and enhance community resilience is encouraged. These areas should include sufficient green spaces and infrastructure for stormwater management.	Increase in extreme hot days. Increased flood risk. Increase in extreme rainfall events	Housing and community development Department Technical Services	Long term	Medium

iv. Enhance public transportation and non-motorised mobility. In this action public transportation systems are developed and improved to reduce reliance on private vehicles and lower urban heat. Promote pedestrian and cycling infrastructure.	Increase in extreme hot days. Increased temperature	Project Management and Public Works	Medium term	High

Adaptation programme 3.3: Community Engagement and Capacity Building				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct public awareness campaigns. In this action residents are educated about the importance of green spaces, stormwater management, and climate adaptation. Various media channels and community events will be used to disseminate information and promote best practices.	Increased temperature Increase in extreme rainfall days Increase in extreme hot days	Corporate Services Department in collaboration with Environmental Health and Emergency Services Disaster Management Local media Schools and higher education	Short term	High
ii. Provide training for local authorities and stakeholders. In this action training programs are offered for local authorities, planners, and community leaders on climate-resilient urban planning, green infrastructure, and stormwater management. Partner with educational institutions and NGOs for capacity-building initiatives.	Increase in extreme hot days Increase in extreme rainfall days Future water supply vulnerability	Corporate Services Department in collaboration with universities, NGOs and experts	Medium term	High
iii. Establish community-based monitoring programs.	Increase in extreme rainfall days Water quality degradation Biodiversity loss	Environmental Health and Emergency Services in collaboration with local communities	Medium term	Medium

In this action local communities are involved in monitoring green spaces, stormwater management, and the effectiveness of climate adaptation projects. Training and resources should be provided for citizen science initiatives to gather data and inform adaptive management.		Disaster management		
iv. Develop and implement climate education programs. In this action climate change education and sustainability topics are integrated into school curricula and community education programs. Workshops, field trips, and hands-on activities should be organised to engage students and residents.	Increased temperature Increased variability in annual rainfall Future water supply vulnerability	Corporate Services Department in collaboration with Environmental Health and Emergency Services Disaster management Universities NGOs	Long term	Medium

Adaptation programme 3.4: Ecosystem-Based Adaptation				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Implement green infrastructure projects In this action green infrastructure such as parks, wetlands, and green roofs are developed and maintained to manage stormwater, reduce flooding, and provide recreational spaces.	Increased flood risk Increase in extreme rainfall days Increase in annual rainfall variability	Environmental Health and Emergency Services Department Disaster management Parks and Recreation	Medium term	High
ii. Restore degraded ecosystems In this action reforestation, wetland restoration, and other ecosystem restoration projects are engaged in to enhance natural resilience to climate impacts.	Biodiversity Loss Water quality degradation	Environmental Health and Emergency Services Department	Long term	High
iii. Promote sustainable land use practices In this action sustainable agriculture, forestry, and land management practices that enhance soil	Increase in extreme rainfall Increase erosion Soil degradation Increase fire risk	LED and Tourism Directorate: Agricultural Development Unit	Medium term	Medium

health, reduce erosion, and support water retention are encouraged.		Environmental Health and Emergency Safety Department		
iv. Establish buffer zones and corridors In this action buffer zones are created around critical natural areas and ecological corridors are established to facilitate wildlife movement and reduce habitat fragmentation.	Habitat fragmentation Biodiversity loss Impact of heat extremes, extreme rainfall on wildlife	Environmental Health and Emergency Safety Department in collaboration with ecologist, botany experts	Long term	Medium

5.4. Implementation framework: Goal 4

Goal 4: To increase the adaptive capacity of human settlements to climate change and extreme events.

Adaptation programme 4.1: Heatwave Preparedness and Response				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct heat vulnerability assessment. In this action high risk areas and vulnerable populations such as the elderly, children, and outdoor workers are identified. Areas with high heat exposure should be mapped to prioritise interventions.	Increase in extreme heat days Increased heat stress	Environmental Health and Emergency Safety Department in collaboration with local communities Disaster Management	Short term	High
ii. Develop heatwave early warning systems. In this action systems to provide timely alerts about impending heatwaves are implemented. Multiple communication channels (SMS, radio, community announcements) can be used to reach all residents.	Increase in extreme heat Increased heat stress Increase in heat stroke and other heat related illnesses	Environmental Health and Emergency Safety Department in collaboration with IT services, community outreach and media relations.	Short term	High
iii. Establish cooling centres. In this action community facilities such as libraries, schools, and recreation centres are utilised as cooling centres during heatwaves.	Increase in extreme heat Increased heat stress Increase in heat stroke and other heat related illnesses	Environmental Health and Emergency Safety Department Disaster Management	Short term	High

These centres should be equipped with sufficient cooling mechanisms and drinking water.				
iv. Train healthcare workers and emergency responders. In this action training is provided to healthcare workers and emergency responders on heat illness prevention, recognition and treatment. Emergency services should be equipped with necessary supplies to handle heat-related emergencies.	Increase in extreme heat Increased heat stress Increase in heat stroke and other heat related illnesses	Environmental Health and Emergency Safety Department Department of Health	Short term	High
v. Implement urban greening initiatives. In this action tree planting and creation of green spaces are increased to reduce the urban heat island effect. The use of green roofs and walls should be encouraged to provide natural cooling.	Increase in extreme heat Increased heat stress Increase in heat stroke and other heat related illnesses	Urban Planning Department in collaboration with environmental department Parks and recreation	Medium term	Medium

Adaptation programme 4.2: Climate-Resilient Infrastructure and Urban Planning				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct vulnerability assessments of critical infrastructure. In this action the resilience of healthcare facilities, schools, housing, and other critical infrastructure to climate impacts are assessed. Areas should be identified and prioritised for retrofitting and upgrades.	Increased temperatures Increase in extreme heat days Increase in extreme rainfall days Increased variability in annual rainfall	Project Management and Public Works Department Disaster Management Local Municipalities: Technical Services	Short term	High
ii. Implement low-cost retrofitting measures. In this action existing buildings are retrofitted with improved insulation, reflective roofing materials, and enhanced drainage systems to handle increased rainfall and reduce flooding risks.	Increase in extreme rainfall days Increased temperatures Increased flood risk	Project Management and Public Works Department Disaster Management	Medium term	High

iii. Update Zoning Regulations and Building Codes. In this action climate resilience measures are incorporated into zoning regulations and building codes to guide sustainable development. Provisions for green spaces, stormwater management, and fire-resistant materials should be included.	Increase in extreme rainfall events Increased wildfire risk	Urban Planning and Development in collaboration with relevant stakeholders Disaster Management Urban development and planning	Medium term	High
iv. Promote mixed-use development. In this action the development of mixed-use areas that combine residential, commercial, and recreational spaces to reduce urban sprawl and enhance community resilience are encouraged. These areas should include green spaces and infrastructure for stormwater management.	Urban sprawl Increase in extreme heat days	Urban Development and Planning Department	Long term	Medium

Adaptation programme 4.3: Water Security and Management				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Enhance water conservation and efficiency. In this action the use of water-saving devices and appliances in households and businesses are promoted. Public education campaigns should be conducted on the importance of water conservation.	Increased temperatures Increase in annual rainfall variability Future water supply vulnerability	Project Management and Public Works Department: Water Directorate Disaster Management Local municipalities: Technical Services Environmental Department Local Business	Short term	High
ii. Develop and maintain rainwater harvesting systems. In this action community-based rainwater harvesting projects are implemented and the installation of rainwater tanks in homes and public buildings are encouraged.	Increase in annual rainfall variability Increase in extreme rainfall days Future water supply vulnerability	Environmental Health and Emergency Safety Disaster Management Local municipalities: Technical Services	Medium term	High
iii. Protect and restore water sources. In this action protection zones are established around critical water sources to prevent pollution and watershed management practices are engaged in to maintain healthy water ecosystems.	Increase in annual rainfall variability Water quality degradation Pollution Water lettuce clogging river systems	Environmental Health and Emergency Safety Local municipalities: Technical Services	Medium term	High
iv. Improve infrastructure for water storage and distribution. In this action existing water storage facilities are upgraded to increase capacity and repair water distribution networks to reduce leaks and inefficiencies.	Increase in annual rainfall variability Increase in extreme rainfall days Future water supply vulnerability	Project Management and Public Works Department: Water Directorate Local municipalities: Technical Services	Medium to Long term	Medium

Adaptation programme 4.4: Community Engagement and Capacity				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**

i. Facilitate participatory climate risk assessments. In this action community members are engaged in identifying local climate risks and vulnerabilities through participatory mapping and other tools.	Increase in extreme heat days Increase in extreme rainfall days Increased flood risk Future water supply vulnerability	Environmental Health and Emergency Safety in collaboration with corporate services Disaster Management	Short term	High
ii. Develop community resilience plans. In this action the district and its municipalities collaborate with local stakeholders to create tailored resilience plans addressing specific climate risks, including clear roles and responsibilities for implementation.	Increase in extreme heat days Increase in extreme rainfall days Increased flood risk	Environmental Health and Emergency Safety Department in collaboration with local communities Disaster Management	Medium term	High
iii. Provide capacity-building workshops and training. In this action training sessions on climate adaptation, disaster preparedness, and emergency response are offered to empower community leaders and local organisations.	Increase in extreme heat days Increased flood risk Increase in extreme rainfall days	Environmental Health and Emergency Safety Department in collaboration with educational institutions and NGOs Disaster Management	Short term	High
iv. Strengthen social networks and support systems. In this action the formation of neighbourhood associations, peer support groups, and other community networks are promoted to improve collective resilience to climate impacts.	Increased vulnerability during extreme events Social isolation	Corporate Services Department Disaster Management NGOs Local community	Medium term	Medium

5.5. Implementation framework: Goal 5

Goal 5: To increase resilience of the agricultural sector to more extreme events such as heatwaves and storms as well as indirect risks such as pests and diseases

Adaptation programme 5.1: Climate-Resilient Agricultural Practices				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Implement conservation agriculture techniques. In this action practices such as minimal soil disturbance, permanent soil cover, and crop rotation to improve soil health and water retention are promoted.	Reduced crop yields Soil degradation Water scarcity	LED and Tourism Directorate: Agricultural development unit Agricultural Department	Short term	High
ii. Adopt drought-resistant crop varieties. In this action the use of drought-resistant and heat-tolerant crop varieties are introduced to ensure productivity during periods of water scarcity and high temperatures.	Heat stress Reduced crop yields	LED and Tourism Directorate: Agricultural development unit Agricultural Department Universities Research institutions	Medium term	High
iii. Implement Integrated Pest Management (IPM). In this action IPM strategies that combine biological, cultural, physical, and chemical tools to manage pests and diseases sustainably are developed and promoted.	Pest and disease outbreak Reduced crop yield	LED and Tourism Directorate: Agricultural development unit Agricultural Departments Universities Research institutions	Short term	Medium
iv. Utilise shade structures and windbreaks. In this action shade structures and windbreaks are established to protect crops from heatwaves and storms, and to reduce soil moisture loss.	Heatwaves Soil erosion	LED and Tourism Directorate: Agricultural development unit	Medium term	Medium

Adaptation programme 5.2: Water Management and Conservation				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Install efficient irrigation systems. In this action the use of drip irrigation and other water-efficient systems to minimise water use and maximise crop yields are promoted.	Water scarcity Drought	LED and Tourism Directorate: Agricultural development unit Department of Water Affairs	Short term	High
ii. Develop rainwater harvesting systems. In this action rainwater harvesting infrastructure is implemented on farms to collect and store rainwater for irrigation and other agricultural uses.	Water scarcity Increased variability in rainfall	LED and Tourism Directorate: Agricultural development unit Technical Services	Medium term	High
iii. Promote water-saving practices. In this action farmers are educated on practices such as mulching, contour farming, and the use of cover crops to conserve soil moisture.	Water scarcity Soil erosion	LED and Tourism Directorate: Agricultural development unit	Short term	High
iv. Construct farm ponds and reservoirs. In this action the construction of small-scale ponds and reservoirs on farms to store runoff water for irrigation and livestock use are supported.	Increased variability in annual rainfall Water scarcity	LED and Tourism Directorate: Agricultural development unit Agricultural department	Medium term	High

Adaptation programme 5.3: Livestock and Pasture Management				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Improve pasture management practices. In this action rotational grazing and other sustainable pasture management techniques are implemented to maintain pasture health and productivity.	Increase in temperature Heatwaves	LED and Tourism Directorate: Agricultural development unit	Short term	High

ii. Enhance livestock housing and shelter. In this action livestock housing is constructed or retrofitted to provide adequate ventilation, shade, and protection from extreme weather.	Increase in temperature Heatwaves	LED and Tourism Directorate: Agricultural development unit Agricultural Department	Medium term	High
iii. Develop feed and fodder banks. In this action feed and fodder banks are established to ensure a stable supply of animal feed during periods of drought or extreme weather.	Increase in temperature Increase in extreme rainfall Increase in extreme heat days	LED and Tourism Directorate: Agricultural development unit	Medium term	Medium
iv. Implement heat stress management practices. In this action practices such as providing cool drinking water, shade structures, and cooling systems for livestock during heatwaves are introduced.	Increase in temperature Increase in heat days Heatwaves	LED and Tourism Directorate: Agricultural development unit Agricultural department	Short term	High

Adaptation programme 5.4: Capacity building and Knowledge Sharing				
Adaptation Actions	**Key risk or vulnerability addressed**	**Responsible entity**	**Timeframe**	**Priority level**
i. Conduct climate resilience training for farmers. In this action workshops and training sessions are organised to educate farmers on climate-resilient practices, technologies, and strategies.	Increase in extreme rainfall Increase in extreme heat days	LED and Tourism Directorate: Agricultural development unit	Short term	High
ii. Develop and disseminate climate change information. In this action systems are established to provide timely and accurate climate forecasts and advisories to farmers to inform decision-making.	Increase in extreme rainfall Increase in extreme heat days Increased variability in annual rainfall	LED and Tourism Directorate: Agricultural development unit in collaboration with South African Weather Service, local media and ICT services to broadcast information	Medium term	High

iii. Promote farmer to farmer knowledge exchange. In this action networks and platforms for farmers to share experiences and best practices in climate-resilient agriculture are facilitated.	Increase in extreme rainfall Increase in extreme heat days Increased variability in annual rainfall	LED and Tourism Directorate: Agricultural development unit	Short term	Medium
iv. Establish agricultural extension services. In this action agricultural extension services to provide ongoing support and advice to farmers on adapting to climate change are strengthened.	Increase in extreme rainfall Increase in extreme heat days Increased variability in annual rainfall	Agricultural Extension Services Agricultural department	Medium term	High

6. Recommendations for Mainstreaming

Mainstreaming is the process of integrating climate change considerations into existing sectoral plans, other instruments and decision-making processes across various sectors and levels of governance. It involves recognising that climate change impacts and risks cut across multiple sectors and require a holistic approach to address effectively. Mainstreaming supports and enables the implementation of climate adaptation measures.

Mainstreaming climate change involves several key elements, and recommendations are made in terms of each of these:

- **Policy integration**: Embedding evidence of climate change, as well as climate change adaptation and mitigation considerations into sectoral policies and strategies, such as those related to disaster risk management, energy, water resources, transportation, and urban planning. This ensures that climate change is not treated as a standalone issue but is instead integrated into broader development agendas.
- **Institutional integration**: Incorporating climate change responsibilities and expertise within departments. This may involve establishing a dedicated but decentralised climate change unit, as well as fostering collaboration and coordination among departments and relevant external stakeholders. Incorporating climate response outcomes in the KPIs of all relevant departments, will ensure that progress towards climate goals can be tracked and measured.
- **Capacity building**: Enhancing the knowledge, skills, and capacities of politicians, decision-makers, and practitioners to understand and address climate change effectively. This includes providing training, technical assistance, and access to relevant information and tools, such as the GreenBook. By improving their understanding of climate change and the need for adaptation, these groups can better integrate climate considerations into their work.
- **Budgeting and financing**: Allocating resources and funding to support climate change adaptation and mitigation activities within existing budgets and financing mechanisms. This may involve reallocating funds from other priorities, leveraging external sources of finance, or integrating climate considerations into budget planning processes. Various funding mechanisms are available to support climate change response initiatives, including national and international grants, public-private partnerships, and municipal budgets.
- **Establishing networks and partnerships:** Establishing networks or partnerships with civil society organisations, research councils, the private sector, different spheres of government, and other relevant entities could bolster climate adaptation efforts.
- **Monitoring and evaluation**: Establishing systems for monitoring and evaluating the effectiveness of mainstreaming efforts and tracking progress towards climate-related goals and targets. This helps ensure accountability and facilitates learning and adaptation over time.

Climate change mainstreaming is essential for building resilience and promoting sustainable development in the face of climate change. By integrating climate considerations into decision-making processes and actions across sectors, mainstreaming helps minimise future risks, maximise opportunities for adaptation and mitigation, and enhance overall resilience to climate change impacts.

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